

Electron Emission of the Cathode of an Arc

IN the carbon- and tungsten-arc the electrons are in most cases emitted thermionically by the cathode, while in the mercury-arc (with mercury cathode) the cathode current is assumed to be due to the emission of electrons from a cold cathode by the high field before the cathode (field current). This high field is generated by the space charge of the positive ions flowing to the cathode.

I think there is still another way in which the cathode of an arc may in some cases emit electrons. If the metallic cathode of an arc (for example, an iron- or copper-arc) is, at least at some spots, covered with a thin layer of an insulator (thickness 10^{-4} – 10^{-5} cm.), a number of positive ions on the surface of the insulator can give a high field near the metal, which will emit electrons through the insulator (field current); the electrons will enter the gas with a high velocity and only few of them will recombine with the ions on the surface. The greater part of the cathode drop will be present on the insulator, and the potential difference on the space charge layer in the gas will be small. (It may be that the breakdown of the insulator causes the wandering of the cathode spot of an arc in some cases.)

This mechanism is analogous to the mechanism of a low current discharge, discovered by Güntherschulze and Fricke¹. If a carbon cathode is covered with a thin layer of an insulator, a glow discharge without Crookes's dark space is observed, called by these authors *Spritzentladung*. The potential difference on the discharge may be much less than the normal values of the cathode drop of a glow discharge. The electrons enter the gas with a velocity almost as great as is due to the potential difference on the insulator. If the insulator is mounted on a metal instead of on carbon, little sparks are seen on the cathode. This difference may be due to the lower electron concentration and the lower field current density in carbon, as compared with a metal.

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Jan. 6.

¹ *Z. Phys.*, **86**, 451 and 821 (1933); **92**, 728 (1934).

Dissociation of Strong Electrolytes in Concentrated Solutions

IN the previous work of one of the authors, it was shown, by a study of the Raman effect, that while nitric acid¹ and sulphuric acid² progressively dissociate with dilution, the nitrates³ are completely dissociated at all concentrations. The study has now been extended to a large number of strong electrolytes, and the results obtained indicate the following general characteristics:

(1) All the oxy-acids dissociate progressively with increasing dilution.

(2) The halogen acids, however, are completely dissociated even in concentrated solutions.

(3) The acid salts of the alkalis are completely dissociated into the alkali ion and the acid radical, the further dissociation of the latter being progressive.

(4) All other salts of the alkalis and alkaline earths are completely dissociated even in saturated solutions.

The explanation of the above results seems to be simple on the basis of the electronic theory of valency. The alkali and the alkaline earth elements, being strongly electrovalent, have their octet outer electronic structures easily completed, so that the stability of both the anions and the cations is great enough to prevent recombination of them into undissociated molecules. Thus, they are able to exist independently in the completely dissociated condition even in the crystalline state. In the state of solution, the dielectric constant of the solvent facilitates the further separation of these ions, which are, therefore, completely dissociated.

The hydrogen atom, however, is different from the alkalis in that it is capable of forming both the electrovalent and covalent bonds. This dual property of hydrogen enables it to form both types of molecules with the anions, those with the electrovalent link which are completely dissociated and others with the covalent link which are in the undissociated condition. At every concentration of the electrolyte, there is equilibrium between these two types of molecules. With decreasing concentration, this equilibrium changes, the molecules with the covalent link changing to those with the electrovalent link.

The exceptional behaviour of the halogen acids remains to be explained. It appears probable that the monovalent halogen ions, being more strongly electrovalent than the anions of the oxy-acids, can form only electrovalent or a very weak covalent bond with the hydrogen and hence are completely dissociated. The presence of Raman lines due to the undissociated molecules in the gaseous and liquefied state of these substances may be due to the weak covalent bond between the hydrogen and the halogens, which easily breaks up in the presence of a solvent of high dielectric constant.

Thus, though for dilute solutions, Debye was able to assume complete dissociation of all strong electrolytes, such a single generalisation does not seem to be possible for concentrated solutions. While all electrovalent bonds in strong electrolytes are completely broken down even in concentrated solutions, covalent bonds, possible only between the anions and the hydrogen ion, change progressively into the electrovalent type with dilution, which then leads to complete dissociation.

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Jan. 16.

¹ *Proc. Roy. Soc., A*, **127**, 279 (1930).
² *Ind. J. Phys.*, **8**, 123 (1933).
³ *Proc. Roy. Soc., A*, **144**, 159 (1934).

Exhibition of 'Autogenous' and 'Stenogamous' Characteristics by *Theobaldia subochrea*, Edwards (Diptera, Culicidæ)

OF the various idiosyncrasies of mosquitoes, laying fertile eggs without a previous meal of blood (autogeny) and mating within very small cages (stenogamy) are among the most unusual. Exhibitions of the former peculiarity have hitherto been provided exclusively by different 'strains' of the mosquito which Roubaud has named *Culex pipiens* var. *autogenicus*¹ but for which (as previously stated) we advocate the adoption of a different specific name². The latter